



Western Technical College

32412414 Diesel Hydraulic/Hydrostatic Systems

Course Outcome Summary

Course Information

Description	This course is a practical study of diagnosis, repair, and failure analysis of hydraulic and hydrostatic systems.
Career Cluster	Transportation, Distribution and Logistics
Instructional Level	Technical Diploma Courses
Total Credits	3
Total Hours	108

Pre/Corequisites

Prerequisite	32412400 Diesel Truck Preventive Maintenance
Prerequisite	32412401 Diesel Truck Powertrains
Prerequisite	32412351 Diesel Truck Brake Systems
Prerequisite	32412402 Diesel Truck Chassis Systems
Prerequisite	32412403 Diesel Online Service Utilization
Prerequisite	32412404 Diesel Safety and Industry Practices
Prerequisite	32412405 Diesel Heavy Truck and Forklift Familiarization
Prerequisite	32412406 Diesel Electricity Fundamentals
Prerequisite	32412407 Diesel Electricity Troubleshooting
Prerequisite	32412303 Diesel Basic Engines

Textbooks

Hydraulic Systems for Mobile Equipment. 2nd Edition. Copyright 2023. Dell, Timothy W. Publisher: Goodheart-Wilcox Co. **ISBN-13:** 978-1-63776-126-7. Required.

Heavy Equipment Power Trains and Systems. 2nd Edition. Copyright 2024. Dell, Timothy W. Publisher: Goodheart-Wilcox Co. **ISBN-13:** 978-1-68584-445-5. Required.

Learner Supplies

Safety glasses with side eye protection that meet Z87 OSHA guidelines. **Vendor:** To be discussed in class. Required.

Six inch ankle high, quality leather work shoes - \$75.00-100.00. **Vendor:** To be discussed in class. Required.

Uniform: Four black/grey shirts with embroidered name. **Vendor:** Campus Shop. Required.

Success Abilities

1. Cultivate Passion: Enhance Personal Connections
2. Cultivate Passion: Expand a Growth-Mindset
3. Cultivate Passion: Increase Self-Awareness
4. Live Responsibly: Develop Resilience
5. Live Responsibly: Embrace Sustainability
6. Live Responsibly: Foster Accountability
7. Refine Professionalism: Act Ethically
8. Refine Professionalism: Improve Critical Thinking
9. Refine Professionalism: Participate Collaboratively
10. Refine Professionalism: Practice Effective Communication

High Impact Practices

1. Learning Community: these courses are designed to enhance your learning experience in which a cohort of peers complete two or more courses that are linked through projects, themes, or program emphasis.

Program Outcomes

1. Diagnose, repair and service steering & suspension systems
2. Diagnose, repair and service drive train systems
3. Diagnose, repair and service hydraulic systems

Course Competencies

1. **Summarize hydraulic and hydrostatic principles.**

Assessment Strategies

- 1.1. Written Product
- 1.2. Skill Demonstration

Criteria

You will know you are successful when:

- 1.1. you examine that fluids have no shape of their own, are practically incompressible, apply equal pressure in all directions, and provide great increases in work force.
- 1.2. you explore the function of a reservoir, pump, filters, relief valve, control valve, and cylinder in relation to each other.
- 1.3. you identify that open and closed center systems are determined by one or all of the following: the type of control valve, the type of pump, use of unloading valve, path of oil return to reservoir from pump.
- 1.4. you describe a basic but complete open center hydraulic system explaining the operation of the system, the route of fluid during the use of a function, and the route of the fluid while the machine is running when no hydraulic function is being used.
- 1.5. you describe a basic but complete closed center load sensing hydraulic system explaining the operation of the system, the route of fluid during the use of a function, and the route of the fluid while the machine is running when no hydraulic function is being used.
- 1.6. you identify applications, and the benefits of those applications on construction equipment.
- 1.7. you explore various types of cooling circuits.
- 1.8. you examine the purpose of a charge circuit and how charge pressure relates to hydrostatic system efficiency.
- 1.9. you explain the differences between hydraulic and hydrostatic systems.

Learning Objectives

- 1.a. Characterize fluids used in hydraulic systems.
- 1.b. Identify components of a basic hydraulic system.
- 1.c. Differentiate between open and closed center systems.
- 1.d. Summarize applications of hydraulic systems.

2. Examine hydraulic pump identification and operation.

Assessment Strategies

- 2.1. Written Product
- 2.2. Skill Demonstration
- 2.3. Written Objective Test

Criteria

Performance will meet expectations when:

- 2.1. you explain the different characteristics between various types of pumps, exhibit the ability to follow the oil flow through each pump, both while using a hydraulic function and with no hydraulic function being used.
- 2.2. you identify a gear pump, name all parts, follow the oil flow through a gear pump, identify inlet and outlet ports, and identify the direction of rotation of the pump.
- 2.3. you identify a vane pump, name all parts of a vane pump, follow the oil flow through a vane pump, identify inlet and outlet ports of a vane pump, and identify the direction of rotation of the pump. Explain how a vane pump can be changed to operate in the opposite direction, when applicable.
- 2.4. you identify various piston pumps, name all parts of a piston pump, follow the oil flow through a piston pump, identify inlet and outlet ports of a piston pump (both variable and fixed), and identify the direction of rotation of the pump.
- 2.5. you identify types of swash plate control: manual, servo piston, electronic.

Learning Objectives

- 2.a. Identify gear, vane and piston pumps, including their parts.
- 2.b. Explain function and applicability of gear, vane and piston pumps.
- 2.c. Identify types of swash plate control.

3. Examine hydraulic motor identification and operation.

Assessment Strategies

- 3.1. Written Product
- 3.2. Skill Demonstration
- 3.3. Written Objective Test

Criteria

You will know you are successful when:

- 3.1. you explain the different characteristics between the various motors; exhibit the ability to follow the oil flow through each motor while using a hydraulic function.
- 3.2. you identify a gear motor, name all parts of a gear motor, follow the oil flow through a gear motor, identify inlet and outlet ports of a gear motor, and identify the direction of rotation of the motor.
- 3.3. you identify a vane motor, name all parts of a vane motor, follow the oil flow through a vane motor, identify inlet and outlet ports of a vane motor, and identify the direction of rotation of the motor
- 3.4. you identify radial and axial piston motors, name all parts of these piston motors, follow the oil flow through these piston motors, identify inlet and outlet ports of these piston motors (both variable and fixed), and identify the direction of rotation of the motors.
- 3.5. you identify a gerotor motor, name all parts, and understand its operation.

Learning Objectives

- 3.a. Compare various motors.
- 3.b. Identify gear, vane, piston, and gerotor motors, including their parts.
- 3.c. Identify oil flow through, inlet and outlet ports, and direction of rotation of gear, vane and piston motors.

4. Examine function and operation of hydraulic valves.

Assessment Strategies

- 4.1. Written Product
- 4.2. Skill Demonstration
- 4.3. Written Objective Test

Criteria

You will know you are successful when:

- 4.1. you explain the differences between these three major hydraulic valve types: pressure control valves, directional control valves, volume control valves.
- 4.2. you explain the functions of the following valves: direct acting relief valves, pilot operated relief valves, cartridge relief valves, pilot operated valves, sequence valves, unloading valves, multi-function valves, counterbalance valves, pressure reducing valves, pressure limiting valves.
- 4.3. you explain the functions of the following valves: check valves, rotary valves, spool valves, pilot controlled poppet valves.

Learning Objectives

- 4.a. Compare the three major types of hydraulic valves.
- 4.b. Explain the functions and uses of pressure control valves.
- 4.c. Explain the functions and uses of directional control valves.

5. Investigate electro-hydraulics.

Assessment Strategies

- 5.1. Written Product
- 5.2. Skill Demonstration
- 5.3. Written Objective Test

Criteria

You will know you are successful when:

- 5.1. you explain the functions of the following valves: electro-hydraulic valves, electro-hydraulic control systems, pulse width modulated valves.
- 5.2. you explain the functions of the following valves: flow control valves (compensated, non-compensated); flow divider valves (priority, non-priority, proportional).

Learning Objectives

- 5.a. Explore electro-hydraulic valves, control systems, and pulse width modulation.
- 5.b. Explain functions and uses of volume control valves.

6. Compare single acting and dual acting cylinders.

Assessment Strategies

- 6.1. Written Product
- 6.2. Skill Demonstration

6.3. Written Objective Test

Criteria

You will know you are successful when:

- 6.1. you explain the uses and movements of the two types of cylinders.
- 6.2. you identify a single acting cylinder, name all of its parts, and follow the oil flow through the cylinder.
- 6.3. you describe the operation of a cushioned cylinder.
- 6.4. you identify a double acting cylinder, name all of its parts, and follow the oil flow through the cylinder.

Learning Objectives

- 6.a. Identify single-acting and double-acting cylinders, including their parts.
- 6.b. Compare operation and applicability of single-acting and double-acting cylinders.

7. Investigate accumulator identification and operation.

Assessment Strategies

- 7.1. Written Product
- 7.2. Skill Demonstration
- 7.3. Written Objective Test

Criteria

You will know you are successful when:

- 7.1. you explain how accumulators store energy, absorb shocks, build pressure, and maintain a constant pressure within a system.
- 7.2. you explain where and why gas, pneumatic, spring loaded, and weighted accumulators are used.
- 7.3. you explain and practice all accumulator safety practices.

Learning Objectives

- 7.a. Explain operation and use of accumulators.
- 7.b. Identify various types of accumulators.
- 7.c. Explain accumulator safety practices.

8. Examine fluids, transfer components, and filtering in hydraulic systems.

Assessment Strategies

- 8.1. Written Product
- 8.2. Skill Demonstration
- 8.3. Written Objective Test

Criteria

You will know you are successful when:

- 8.1. you select the proper hose for a given function, taking into consideration the flow needed, pressures to be used, routing, clamping, fittings required, and pulsating of lines.
- 8.2. you describe hydraulic fittings, the importance of selecting the proper fitting, and their relationship to noise and vibration.
- 8.3. you identify various fittings and thread styles, such as o-ring boss, NPT, NPTF, British Metric, o-ring flange, ORFS.
- 8.4. you demonstrate the ability to crimp hydraulic fittings onto hose.
- 8.5. you identify use of various filters in hydraulic and hydrostatic systems.
- 8.6. you explain the concept of auxiliary by-pass filtration and its benefits to total system cleanliness.
- 8.7. you identify proper procedure to torque fittings and flanges.

Learning Objectives

- 8.a. Explain the construction, function and use of hoses used in hydraulic systems.
- 8.b. Identify various fittings and thread styles used in hydraulic systems.
- 8.c. Explain the construction and function of filters used in hydraulic/hydrostatic systems.

9. Demonstrate hydraulic maintenance and safety procedures.

Assessment Strategies

- 9.1. Written Product
- 9.2. Skill Demonstration
- 9.3. Written Objective Test

Criteria

You will know you are successful when:

- 9.1. you practice good hydraulic maintenance/safety practices.
- 9.2. you perform all hydraulic functions and repairs in a clean atmosphere.
- 9.3. you follow the proper flushing procedure using the correct technical manual/service information.
- 9.4. you perform the proper maintenance techniques to prevent internal and external leaks.
- 9.5. you demonstrate the procedure for cleaning hoses after cutting and crimping.
- 9.6. you prevent overheating by keeping the oil at the proper levels, cleaning dirt and mud from around lines and cylinder rods, keep relief valves adjusted properly, do not overload or overspeed systems, and do not hold control valves in a position longer than necessary.
- 9.7. you identify the root causes of "blistering" or frayed hoses and procedures to avoid these problems.
- 9.8. you describe oils and show familiarity with various fluids and their effects on hydraulic systems.
- 9.9. you describe the effects of mixing oil types.
- 9.10. you describe ISO cleanliness code principles.
- 9.11. you identify key elemental categories.
- 9.12. you obtain fluid samples from a system using proper procedures.
- 9.13. you identify key elements found in oil analysis and the types of failures related to each.
- 9.14. you identify key indicators on a fluid analysis report that illustrate: (1. The proper fluid type is being used. 2. Fluid types have not been mixed. 3. Indicators of fluid degradation. 4. Trend analysis.).
- 9.15. you identify aeration including the root cause.
- 9.16. you describe how reactions of some sealant materials differ among types of hydraulic fluids.
- 9.17. you describe the applications of various types of sealants.
- 9.18. you ensure safety practices are followed.

Learning Objectives

- 9.a. Demonstrate safe procedures in flushing systems, preventing leaks, preventing overheating, and identifying defective or worn hoses.
- 9.b. Explain the characteristics of hydraulic oils.
- 9.c. Summarize fluid analysis reports.
- 9.d. Explain variety of materials and types of seals/gaskets used in hydraulic systems.

10. Demonstrate hydraulic component repair and replacement.

Assessment Strategies

- 10.1. Written Product
- 10.2. Skill Demonstration
- 10.3. Written Objective Test

Criteria

You will know you are successful when:

- 10.1. following the proper technical manual/service information, you exhibit the ability to remove, disassemble, diagnose failure, evaluate, repair or replace/reinstall, and test operate any given component including but not limited to: gear, vane, and piston pumps; gear, vane, and piston motors; pressure control valves; directional control valves; volume control valves; single acting and double acting cylinders.
- 10.2. following the proper technical manual/service information, you exhibit the ability to remove and replace any given component including but not limited to: gear, vane, and piston pumps; gear, vane, and piston motors; pressure control valves; directional control valves; volume control valves; single-acting and double acting cylinders; gas, pneumatic, spring and weight loaded accumulators; hoses, steel lines and fittings; oil coolers; reservoirs.
- 10.3. you describe proper system flushing/cleanup procedures to achieve ISO cleanliness code.
- 10.4. you perform proper bleeding and priming procedures.

Learning Objectives

- 10.a. Evaluate component parts to determine need for repair.
- 10.b. Demonstrate component part repair, including replace/reinstall and test operate.
- 10.c. Explain when hydraulic components need to be replaced.
- 10.d. Demonstrate replacement of hydraulic components.

11. Interpret hydraulic schematics.

Assessment Strategies

- 11.1. Written Product
- 11.2. Skill Demonstration
- 11.3. Written Objective Test

Criteria

Performance will meet expectations when:

- 11.1. you demonstrate symbol identification.
- 11.2. you use JIC, ISO, and various symbols to identify locations of various components.

Learning Objectives

- 11.a. Identify symbols in relation to the hydraulic component they represent.
- 11.b. Identify position of any given component by reading a schematic.
- 11.c. Explain the application of hydraulic schematics.

12. Demonstrate hydraulic system and component troubleshooting.**Assessment Strategies**

- 12.1. Written Product
- 12.2. Skill Demonstration
- 12.3. Written Objective Test

Criteria

You will know you are successful when:

- 12.1. you demonstrate reasoning with regard to a specific malfunction.
- 12.2. you exhibit mastering the use of all test equipment including flow meters, pressure gauges, vacuum gauges, and temperature measuring devices in both the metric and standard scales.
- 12.3. you demonstrate the ability to use schematic diagrams and follow a troubleshooting flow chart using a selected technical manual.
- 12.4. you demonstrate the ability to follow an operational check procedure using a selected technical manual.
- 12.5. you troubleshoot load-sensing hydraulics.
- 12.6. you demonstrate technical write-up competency: identify, evaluate, and diagnose customer complaint; identify the root cause of failure; correction procedure; machine inspection.

Learning Objectives

- 12.a. Demonstrate troubleshooting procedures to diagnose hydraulic/hydrostatic malfunction.
- 12.b. Demonstrate troubleshooting of load-sensing hydraulics.
- 12.c. Document findings correctly.